Early Journal Content on JSTOR, Free to Anyone in the World

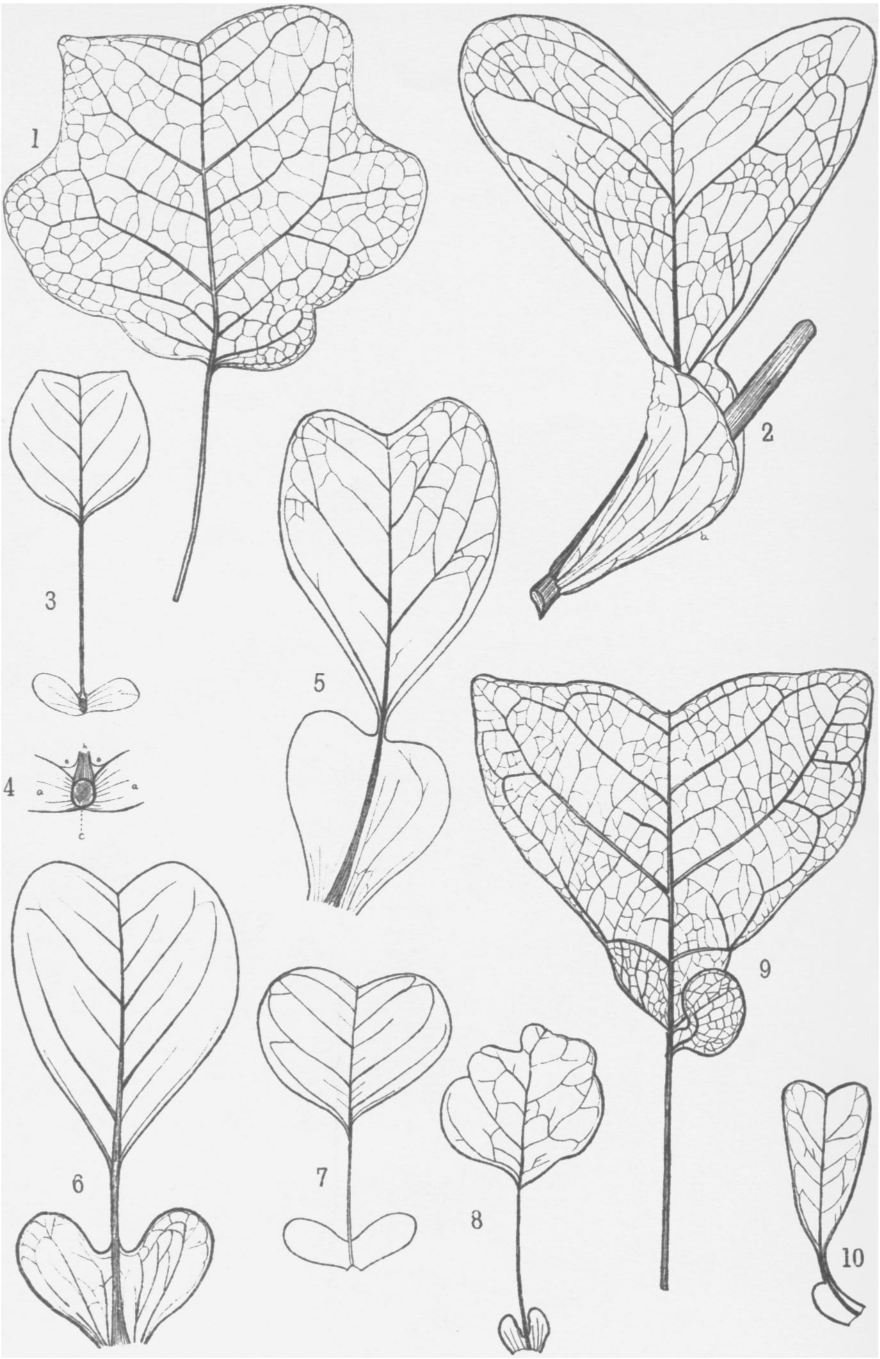
This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

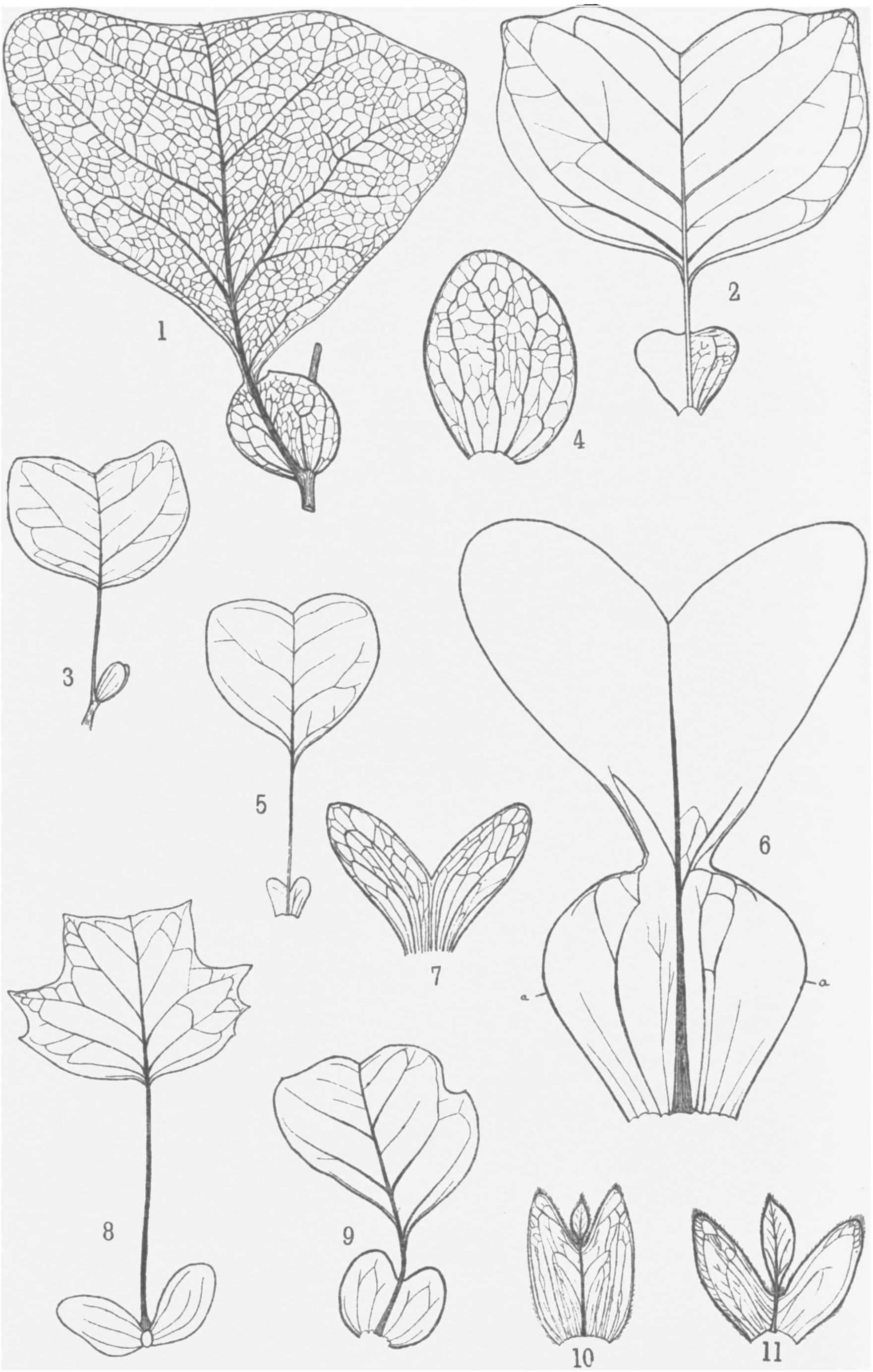
Read more about Early Journal Content at http://about.jstor.org/participate-jstor/individuals/early-journal-content.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.



STIPULES OF LIRIODENDRON.

THE HELIOTYPE PRINTING CO., BOSTON.



STIPULES OF LIRIODENDRON.

THE HELIOTYPE PRINTING CO., BOSTON.

VOL. 28 NO. 9

BULLETIN

OF THE

TORREY BOTANICAL CLUB

SEPTEMBER 1901

The Origin of Stipules in Liriodendron

BY EDWARD W. BERRY

(WITH PLATES 41, 42)

In 1894 Dr. Arthur Hollick described * a species of *Liriodendron* from the Laramie formation at Walsenberg, Colorado, under the name of *Liriodendron alatum*, a manuscript name given the specimen by the late Professor J. S. Newberry. It was a large leaf, oblong in outline, with a deeply emarginate apex, and had conspicuously winged petioles. In the same paper a form of *Liriophyllum populoides* Lesq. was described from the Dakota formation, with similarly winged petioles; and Dr. Hollick was led to suggest from these two instances that the large fugacious stipules of our living tulip-tree might represent former leaf-lobes, which, becoming separated, formed basilar lobes, then winged petioles, and finally the modern stipules.

In a subsequent paper † he describes two specimens of leaves of *Liriodendron Tulipifera* Linn., which serve, in a measure, to substantiate this view although it was sharply assailed by Theo. Holm in the Botanical Gazette. ‡

Somewhat similar petiolar appendages in the genus *Platanus* have been ably discussed by Professor Lester F. Ward in several papers, § and his conclusion that the large foliar stipules of the

---

* Bull. Torr. Club, **21**: 467–471. *pl. 220, 221.* 1894.

† Ibid., **23**: 249, 250. *pl. 269, 270.* 1896.

‡ Bot. Gazette, **20**: 312. 1895.

§ Palaeontologic Hist. of the Genus *Platanus*, Proc. U. S. Nat. Mus. **11**: 39–42. *pl. 17–22.* 1888. Origin of Plane Trees, Am. Nat. **24**: 797–810. *pl. 28.* 1890.

[Issued 30 September]

modern tree represent the final stage in development from the basilar leaf-lobes of the Cretaceous species, is amply proven, although questioned in some quarters.* Still another instance where stipules are mentioned as developing from leaf-lobes is implied in the following footnote on page 420 of The Smilaceae of North and Central America. In speaking of those species which climb by means of tendrils growing from the stipular wings on each side of the petiole, Dr. Morong says: "De Candolle regards this appendage as more in the nature of a modified leaf segment or leaflet than a stipule, but it seems to me that a stipule is nothing else than a leaflet at the base of the petiole."† The only other mention of winged petioles in *Liriodendron* so far as I am aware, is a short communication to Meehan's Monthly for August, 1896 (p. 145), from Mrs. W. A. Kellerman recording her observation of several forms with adnate stipules.

The writer has been fortunate in securing a large series of specimens of *Liriodendron Tulipifera* Linn. with winged petioles and adnate stipules in all stages of development, all of which strikingly confirm Dr. Hollick's theory of their origin. We have noted them briefly in the following pages in what seem to be the natural stages of their development as exhibited by our material.

We are greatly indebted to Mrs. W. A. Kellerman, of Columbus, Ohio, for many fine specimens. The first suggestion of basilar lobes is found in an obtusely lobed leaf of the normal size from a sapling. The leaf-blade is extended on each side at the base to form more or less well-defined lobes nearly the size of an ordinary stipule, and strikingly like them in venation, attracting attention at a glance; this is particularly true of the right-hand lobe which is entirely stipular in venation, quite different from the usual venation of the basilar portion of ordinary leaves. These lobes are well shown in Plate 41, Fig. 1. This form undoubtedly represents the first stage the ancestral leaf, or at least its basal portion, assumed in the course of stipular development. We find what we consider analogous basilar lobes or ears in two

---

* Ward's conclusions are rejected by A. G. Nathorst, Rev. of Types of Laramei Flora by L. F. Ward, in Neues Jahrbuch für Mineralogie, **2**: 219–222. 1893.

† Morong, Bull. Torr. Club, **21**: 420, footnote. 1894.

existing species of *Magnolia* from our Southern States, *Magnolia Fraseri* Walt. and *Magnolia macrophylla* Michx. and among ancient species they occur in *Magnolia auriculata* Newb., which is a rather common species in the Amboy Clays of New Jersey and which exhibits almost every stage from leaves with a truncate base to those with an extremely lobed base. We find these forms of especial interest because of the close relationship between *Magnolia* and *Liriodendron*. The leaf figured on Plate 41, Fig. 9 represents the second stage of the series five-eighths natural size. It is a very remarkable specimen, both in shape and venation. Nearly triangular in outline, with an acute base, it bears upon the petiole immediately below the base of the blade, but entirely separated from it, a pair of appendages * shaped like flasks with crooked necks (irregularly umbonate). The upper portion of the appendages overlaps the basilar portion of the leaf, and like it they are very coriaceous, thus differing widely from the thin parenchyma of ordinary stipules. The length of the petiole below the appendages is one and seven-eighths inches, showing that they are true leaf segments and not of stipular origin.

On Plate 42, Fig. 1, is pictured a leaf which was borne on a shoot from an old stump; it is an inverted triangle in rough outline with a truncate apex four and three-quarter inches in width, and tapers to a narrow base: the petiole is short and broadly winged: these wings are continuous with the blade, there being simply a contraction on one side, while on the other side there is a sharp sinus which extends to within one-sixteenth of an inch of the petiole, leaving room however for a plainly marked vein which passes from one to the other: the wings are exactly similar to the blade proper in texture and extend to the base of the petiole, encircling the stem as do true stipules; the right hand wing is the larger of the two and bears a mucronate point at its apex exactly like a true stipule. While the latter might possibly be considered by some as an adnate stipule, the left-hand wing can hardly be considered other than as a winged margin of the petiole in the act of becoming stipular, and rather closely resembles *Liriodendron alatum* Newb. from the Laramie.

---

* The left hand one is broken off in the specimen, but the scar where it was attached is plainly shown.

In the specimen figured on Plate 41, Fig. 2, we have a much smaller leaf, somewhat suggestive of a *Liriophyllum* in outline; the blade is two-lobed at the top, with an emarginate apex, and is constricted at its middle to form two large petiolar wings which encircle the stem and coalesce at the point marked *A*, forming a loose tube. These wings are very large, nearly equalling the leaf-blade proper in size, and the nervation of each extends into the other, as is well shown on Plate 42, Fig. 6, which represents the tube slit open and spread out flat; it will be noticed that one of the primary veins takes its origin in the right-hand wing, a significant fact, showing that if we are to consider these wings as stipular, then we are obliged to consider the leaf-blade proper in this case as an appendage of these stipules which is manifestly not the case, the only alternative being to consider the wings as separated segments of the leaf-blade.

On Plate 41, Fig. 5, we have a larger leaf in a slightly more advanced stage of stipular evolution; the blade proper has a retuse apex, and strongly resembles certain leaves referred to *Liriodendron primaevum* Newb. from the Dakota formation and to *Liriodendron simplex* Newb. from the Amboy Clays. A wide, rounded sinus separates the blade proper from the wings of the petiole, which latter nearly equal the blade proper in size and are continuous with it by means of a narrow margin on each side of the petiole.

Plate 41, Fig. 10, shows a small oblong-cuneate leaf in about the same stage of stipular development as the preceding. The general shape is that of *Liriophyllum obcordatum* Lesq. and the petiole is narrowly winged throughout its whole length; the left-hand margin expands suddenly at a point about half way to the base of the petiole to form a stipule-like wing, while the right-hand margin enlarges gradually until at its base it is about three times as wide as it is at its narrowest part.

Plate 42, Fig. 2, of a much larger leaf, shows us the next step in the chain, with somewhat reduced wings which have become entirely separated from the blade by an interval of petiole which is one-half of an inch long on the right side and five-eighths of an inch long on the left side; the finer venation of the wings is somewhat transverse in its general direction, rather than longitudinal, the usual manner; the union of the wings with the petiole forms an angle of about 90°.

On Plate 42, Fig. 9, we have a slightly more advanced stage than that shown on Plate 42, Fig. 2; the leaf shows traces of lobation and the wings are more like stipules both in shape and venation, and are more separated from the petiole, the angle formed by the union with the latter being about 45°.

In the form shown on Plate 41, Fig. 6, we have the closely succeeding stage in the series. The wings are very broad, being fully as wide as the blade proper. This form resembles Plate 41, Fig. 5, in the outline of its blade, while the wings are but slightly removed from the preceding, being a trifle freer from the petiole.

We place as the next stage in the series Fig. 5 on plate 42, for although the petiole is much lengthened and the wings are considerably reduced, still they are attached to the petiole for over half of their length. Fig. 8, plate 41, closely follows the preceding. While the leaf-blade is of a different shape, the petiole is of similar length and its appendages are similar in size and form; the only difference being that they are free for more than half their length, approaching the next stage in their degree of attachment.

On plate 41, Fig. 7, we have a somewhat more advanced stage; the blade proper is orbicular in general outline with a slightly emarginate apex, exactly similar to dozens of leaves which may be found on young shoots; the distance from the blade to the wings is comparatively great (one and one-quarter inches), almost the same as the length of the blade; wings are attached to the petiole by their bases only and are widely divergent; they are somewhat larger than in the preceding form. From this to the regular modern stipulate form, it is but a step, which interval we bridge over with the form shown on Plate 41, Fig. 3. At first glance the stipules appear entirely free, but closer examination shows that they still retain their connection with the petiole by means of a small triangle of connective tissue (shown enlarged at Fig. 4, Plate 41).

The modern form of stipules is shown in Figs. 3, and 8, on Plate 42, Fig. 3 being the small form the leaf assumes on young shoots and saplings, and Fig. 8 that of the normal modern form of leaf.

In the growth of young and vigorous shoots in the spring time, where there is excessive, or at least a full supply of nourishment, and where the necessity of protecting the unfolding leaflets is more imperative, comparatively immense stipules usually occur; one of these (nat. size) is figured on Plate 42, Fig. 4, in order to show its venation.

Still another form sometimes assumed by stipules is shown in Fig. 7, on Plate 42, reminding one of the curious stipular appendages on some of our magnolias. All degrees of coalescence occur from forms barely united to those united for about half their length like the one figured; we have specimens one-third larger than this.

Figs. 10 and 11 on Plate 42, show the curious stipular forms which occur on *Magnolia obovata* Thunb. and *Magnolia conspicua* Salisb. the only two species which I have had an opportunity of observing. They form large bud scales, affording effective protection for the tender unfolding leaves. In the youngest shown (Fig. 10), they are many times the size of the tiny leaflet they bear, while Fig. 11 shows a larger leaflet.

On comparing this form with those forms of adnate *Liriodendron* stipules shown on Plate 42, Fig. 7, it will be seen that the addition of a petiole with a small leaflet at its summit would make them identical with the magnolia specimen, the venation too is almost identical, that in *Magnolia* being somewhat finer and more reticulate; as the *Magnolia* leaves become older the wings separate along the petiole and fall off. These stipular wings become particularly significant when we consider that *Magnolia* is so closely related to *Liriodendron*, and has several species with basilar lobed leaves. *Magnolia*, as we should naturally expect, is found in older strata than *Liriodendron* and there is no doubt of their community of descent from the same primitive form. It does not seem to me to be necessary to make any further comments on the foregoing; the figures tell the story, and no more perfect series of forms, each slightly removed from its predecessor, could be desired: in fact we are surprised to find the evolution of stipules in this genus which must have occurred in the Cretaceous period, so well portrayed and epitomized after so long an interval of time.

PASSAIC, N. J.